SUPPLY CURRENT USAGE CONTROL SYSTEM

The present invention relates to a supply current usage control system for enabling a person to limit the supply of current to an electrical apparatus to enable only a specified total duration of use of the apparatus over a period of time.

There are various reasons why someone may wish the use of an apparatus to be limited to a maximum duration of use over a period of time. Parents, for example, may wish their child to view television for only a limited number of hours per week, weekend or day, whilst at the same time accepting that the child may decide when, during the week etc., that the actual viewing takes place and whether the viewing will be taken as one session or made up from individual shorter periods. The parents may also wish the same kind of restriction to apply to their child when playing electronic games. For different reasons owners of property may also wish to restrict the total time of usage of certain apparatus by their tenants or customers, e.g. the use of games in a public house.

Timer utilising devices have been proposed into which apparatus can be plugged and which can be programmed to allow use of the plugged-in apparatus only during specified set times. One such unit is disclosed in GB-A- 2 310 323 and incorporates a lockable cover that can be closed and locked, to prevent tampering after the person exercising control has set the timer unit to permit use of the apparatus during a specified time period or periods. However, this device permits use during the full time of all set periods and, unless these are very restricted, the total possible cumulative use may be greater than may be desired by the person wishing to set the duration limit. WO 02/41084 (published on 22 May 2002) discloses a controller for controlling the supply of electrical power to an appliance, the time schedule of the controller being programmable by means of a programming object that is removable from the controller during operation,

According to the present invention a supply current usage control system is provided in or for use in a power supply path for an apparatus, which system comprises;

timer control means which may be set to specify a total time duration for which supply of operating current to said apparatus is to be permitted to flow through the supply path; switch means controllable by the timer control means for permitting or interrupting the flow of operating current through the supply path; and current flow detection means for detecting the flow of apparatus operating current through the supply path and for providing an output to said timer control means indicative of operation of said apparatus to enable determination of the cumulative time of operation of the apparatus.

With such a system the control apparatus can operate the switch means to interrupt the supply of operating current to the apparatus when the control means determines, on the basis of the current flow detection means output signals, that the apparatus has been used for the permitted total time duration. Preferably, the current flow detection means may be set with an offset current threshold whereby standby currents below the threshold are ignored for the purpose of determining the duration of the flow of apparatus operating current indicative of actual operation of the apparatus.

Preferably the timer control means can be set to both to determine a cumulative apparatus operational use period and to specify a specific daily time period or time periods during which this cumulative use period may be built up. With such an arrangement, a parent, for example, may limit not only the total time for which television may be watched but also at which periods during the day it may be watched.

The system may comprise an adapter that can be plugged into an electric supply socket and which can have the apparatus supply cable wired to it or plugged into it and be provided with security arrangements to prevent unauthorised unplugging or unwiring of the apparatus supply cable.

Alternatively the system may be built into a wall socket or into the apparatus to be controlled.

Where a house has multiple units to control and/or multiple users, a system of one master unit and at least one slave unit may be used. In one version, the master

unit serves as both the control on a single piece of apparatus and communicates with the or each slave unit to determine the total usage of all the apparatus so connected by individual users of that apparatus. Thus the or each slave unit contains a subset of the functionality of the master unit. The communication between master and the or each slave unit may be by transmission over mains, IRDA or RF signal.

In another version the master unit functionality is achieved by connection to a personal computer (PC), in which case the required functionality is achieved by provision of programming. Alternatively, the master unit may comprise a PC.

In another version, where a house has a central computer control unit for controlling various household activities and apparatus, a further possibility is for the system to be part of this central computer control unit, with the timing control means being constituted by the central computer unit and the current flow means being incorporated in or in association with a wall socket.

Clearly, it is necessary that the set time period substantially cannot be altered except by the authorised person who set the time in the first place.

A tamper switch arrangement may be provided, which arrangement will produce a signal for said control means to reset the usable period to zero in the event of unauthorised tampering or apparent tampering with the system. The tamper switch may be in the form of a micro-switch with its operating pin or button in contact with the inside of a lockable casing or other security arrangement for the system, for part of the system or for the timer unit of the system and which causes a signal to be sent to the control unit if the casing is opened or attempted to be opened by an unauthorised person.

Physical key operated means or password systems may be provided to ensure time settings may only be changed by those in possession of the key or password.

Audible and/or visual warning means may be provided to give an audible and/or visual signal a specified period before operating supply current is to be switched off by the timer control means.

The timer control means or setting means for the timer control means may be in a remote control unit separate from the wall socket unit or adapter unit containing the current flow detection means and switch means, with wireless signal transmission and reception being provided between the separate units.

For a better understanding of the present invention reference will now be made to the accompanying drawings which show, purely diagrammatically and solely by way of example, an embodiment of the present invention, Figure 1 showing a master unit and Figure 2 showing an associated slave unit, there being at least one such slave unit. In some cases items are represented by blocks and in other cases by more detailed circuit components but the illustrated format is, as stated, intended to be solely an example and not intended to be limiting in any way.

Figures 1 and 2 show a power supply usage control system, in which three supply lines are represented, referenced E, N and L being respectively the earth, neutral and live supply conductors for supplying power to consumer apparatus. The input side of the supply conductors is referenced IN and the output side is referenced OUT. When the control system is provided as an adapter to be connected to the end of a consumer apparatus power cable, OUT represents the cable between the adapter and the apparatus and IN represents the adapter pins that are to be plugged into a wall socket. Alternatively, if the control system is built into a wall socket, IN represents the terminals connected to the house mains wiring and OUT represents the socket terminals of the wall socket to be controlled.

The remainder of the power supply usage control system of the embodiment comprises a number of separate components. Within the master unit these are: time setting means formed by a micro-controller or processor unit 13, a real time clock unit 14, keypad input means 15 and an LCD display 16; a current flow detecting means

shown outlined by dotted lines 8; a tamper switch 18; a warning buzzer 17; switching means, formed by relay 22 and switch contacts and armature 23, to permit or interrupt current flow through the live power supply line L; and AC/DC converter unit 3 to provide a DC supply voltage for the other components of the control system and for transmission. The or each slave unit comprises the same components as the master unit with the optional exception of the LCD screen, the keypad and the real time clock.

Two conductors 1 and 2 connect the neutral N, and live L, supply lines to the AC/DC converter unit 3. Conductor 2 incorporates a fuse 4, to protect the AC/DC converter. AC/DC converter 3 incorporates a transformer T, which has its primary coil connected to the conductors 1 and 2 and its output coil connected to a bridge rectifier unit 5. The rectified output of bridge circuit 5 is passed to a voltage regulator 6, the output voltage +V of which appears between terminals 7 and 8 as the output operating voltage for the control system units. Terminal 8 acts as the earth or ground terminal G as indicated by the earth symbol. Capacitors C5 and C6 are connected in parallel across the output terminals of the bridge rectifier unit 5 and voltage rectifier 6 respectively, to remove AC ripple voltage and to stabilize the output voltage +V. Terminals 7 and 8 are connected to the other units of the control system to provide the DC voltage +V as the DC supply voltage for those units. This is indicated by the terminals referenced +V and G at various locations in the drawing.

The current sensing arrangement 8 incorporates a low value resistance R1 (for example 0.1 ohms) connected in series in the neutral line, N. The voltage developed across this resistance R1 is fed via conductors 10 and 9, capacitors C1, C2 and resistances R4 and R2 to the inputs of an operational amplifier 11. Operational amplifier 11 has a bias resistance R3 connected between the R2 input and ground G and a feedback resistance R5, between its output and the input connected to R4 and presents a very high impedance across the input conductors 10 and 9. Operational amplifier 11 produces a half-wave rectified output voltage at its output terminal, which terminal is connected to one input terminal of an operational amplifier 12 by a series resistance R6. A capacitance C3 is connected between this terminal and ground G such that, with

resistance R6, it forms a filter to smooth out the AC component of the output of amplifier 11 so as to provide a substantially DC level, operating current representative, signal at the amplifier 12 output. The other input terminal of amplifier 12 is connected to the connection point between two resistances R7 and R8 which are connected in series between +V and ground potential. The values of resistances R7 and R8 are chosen to determine a current detecting operating threshold voltage for the voltage across resistance R1, such that small voltages developed across R1 as a result of small standby currents can be ignored by the current detection arrangement and not used to indicate operative use of connected apparatus. Operational amplifier 12 acts as a comparator and is arranged to provide an effectively digital output signal, with a 0 level output for no, or only stand-by, current through detector resistance R1 and a 1 level output for an apparatus operating current flow through resistance R1.

Within the master unit, the output from the current detection amplifier 12 is fed directly to the microcontroller circuit 13. This microcontroller circuit also receives real time representative signals from the real time clock 14 and can additionally be provided with input signals from the keypad 15. Output signals from the microcontroller are coupled to the LCD display unit 16, the buzzer 17 and to the switching means relay 22.

For the or each slave unit, the output from the current detection amplifier is fed to the microcontroller which transmits this information to the master unit via a data transmission module 24. These signals may be sent by transmission over mains using a protocol such as x-10 or CEBus, which may use a coupling device 25 to connect to the mains conductor, or by radio frequency transmission using a technology such as "bluetooth", or by infrared transmission.

The master unit contains the equivalent means to receive information from the slave units on their current condition and also to transmit control messages to alter their status.

Also, as indicated in the figures, the tamper switch 18 is connected to the microcontroller. As shown, this switch is normally in a closed position such that the voltage +V appears at the output from the tamper switch and is fed to the microcontroller. A parallel arrangement of a resistor R9 and C4 is connected between the input from switch 18 to the microcontroller and ground such that, if the switch 18 is opened, the voltage V on capacitor C4 will discharge to ground via resistance R9 and earth voltage will be applied to the tamper switch input.

Each unit will, in operation, be incorporated either in an adapter, a wall socket or in the input to consumer apparatus and will be protected by a lockable cover for preventing access to control the timing set-up means, with the tamper switch 18 providing an indication of any attempt to open the cover. In the event that the cover is opened, the switch will open and the earth potential tamper signal will be passed to the microcontroller 13. The tamper switch 18 could be positioned such that removal of the plug or adapter would operate the switch to cause resetting to zero of the usage duration available.

The AC/DC converter arrangement 7 simply provides the appropriate operating voltage for use by the other components of the system controller. Obviously, if desired, the converter 7 could be replaced or supplemented by a battery supply arrangement using some form of chargeable or non-chargeable batteries. Use of supplemental batteries would facilitate the retention of time settings in the event of a power failure.

In operating the control system, the person with authority to determine the settings of the system can use the keypad 15 to enter into the master unit microcontroller both the permitted times during a day or week, etc. that a user may operate apparatus connected to the control system. Also this authorised person will enter the permitted total cumulative duration for which the apparatus may be used during the authorised period(s) of use. The real time clock 14 feeds the necessary timing information to the microcontroller and the LCD display can be used during programming of the microcontroller to check the accuracy of inputting of the settings. Subsequently the

display can be operated to display the amount of time for which the connected consumer apparatus has been used and/or the amount of time remaining for which the apparatus can be used. When the cumulative use is approaching the maximum permitted duration of use, the microcontroller device 13 will send a signal to the buzzer 17 to provide an audible warning to the user that the control system is about to operate the switch means 22, 23 to shut down the power supply to the apparatus. A visual indication, e.g. a flashing light (not shown), could also be provided as an alternative or additional warning device.

The actual period of use of the apparatus is determined using the current flow detection means 8. As mentioned above, this current detection means can be set with a threshold so as to detect the difference between standby current and actual operational current for the apparatus. Signals representative of actual operational use are sent from the output of operational amplifier 12, of the detection means 8, to the microcontroller 13 whereupon the master unit microcontroller will sum up the total time of use during a single or multiple periods of use in the permitted time period (s). Periods of non-use during that time period are ignored.

Each user may have an individual pin code which is used to determine the total usage duration for all apparatus available to that individual.

Moreover, multiple pin codes may be entered on a single piece of apparatus to allow shared use of that apparatus and shared permitted time usage.

With this arrangement, the actual user, for example a child, is able to determine exactly when during the permitted periods of operation they will use the apparatus and may use the apparatus for one or several occasions until the total permitted time of use has expired. Therefore, they are given complete personal freedom of choice as to when to use the apparatus and which piece of apparatus to use within an allowed period but at the same time their total usage may be controlled.

The actual implementation of the control system may vary so as to be incorporated within a house control system, operated by a central computer; to comprise adapter arrangements for plugging into wall sockets and to which an apparatus plug may be lockably connected; or to be built into a wall sockets, to which apparatus is connected. Other secure physical housing arrangements for the control system could be envisaged. As well as arrangements for physically locking the system, employing lockable covers, with keys etc., a password control system may be employed either alone or in combination with a locking arrangement.

In each unit, not all of the shown components need to be incorporated into one housing. Some parts, such as the keypad or other setting means may be in a separate control which can operate remote from the adapter or wall socket or house unit. Such an apparatus may link with the other components by means of infra red or other wireless signals in the manner of TV remote controllers. One arrangement for remote control is indicated in the drawing. This arrangement comprises an infrared transmitter/receiver 19 for the micro-controller 13, together with a hand-held remote unit 20. The transmitter/receiver 19 and hand-held remote 20 communicate with each other using infrared signals 21 although other wireless signals could be used as an alternative. Remote controller 21 is provided with a keypad and optionally a display so that the person controlling the system may enter time control signals and receive confirmation of the setting on the display. Remote controllers could be provided for different levels of control as required. If only the power to remotely transmit setting signals is provided, only one way transmission would be required. At the other extreme, with two way transmission, all possible control and display functions could be provided, although, of course, one would need to be within reception range when signals were to be received or transmitted. Normally the remote controller would display or be operable only on request so as to avoid excessive power drain of the unit's battery supply. The remote controller could be provided as an alternative to or in addition to the shown keypad 15 and display 16.

The functions of the keypad or remote control unit will allow a user with the appropriate authorisation code to:-

1. log on as an individual user
2. determine or modify periods within which the apparatus can be used
3. determine or modify duration of use with specified time periods
4. determine or modify which apparatus can be used
5. alter authorisation codes

If wall socket arrangements are used to house the control system, they could be made the size of a normal double socket with one socket being replaced by the usage control system components. Setting could be achieved, as suggested above, using a remote control with both the remote and the wall socket being provided with display units.